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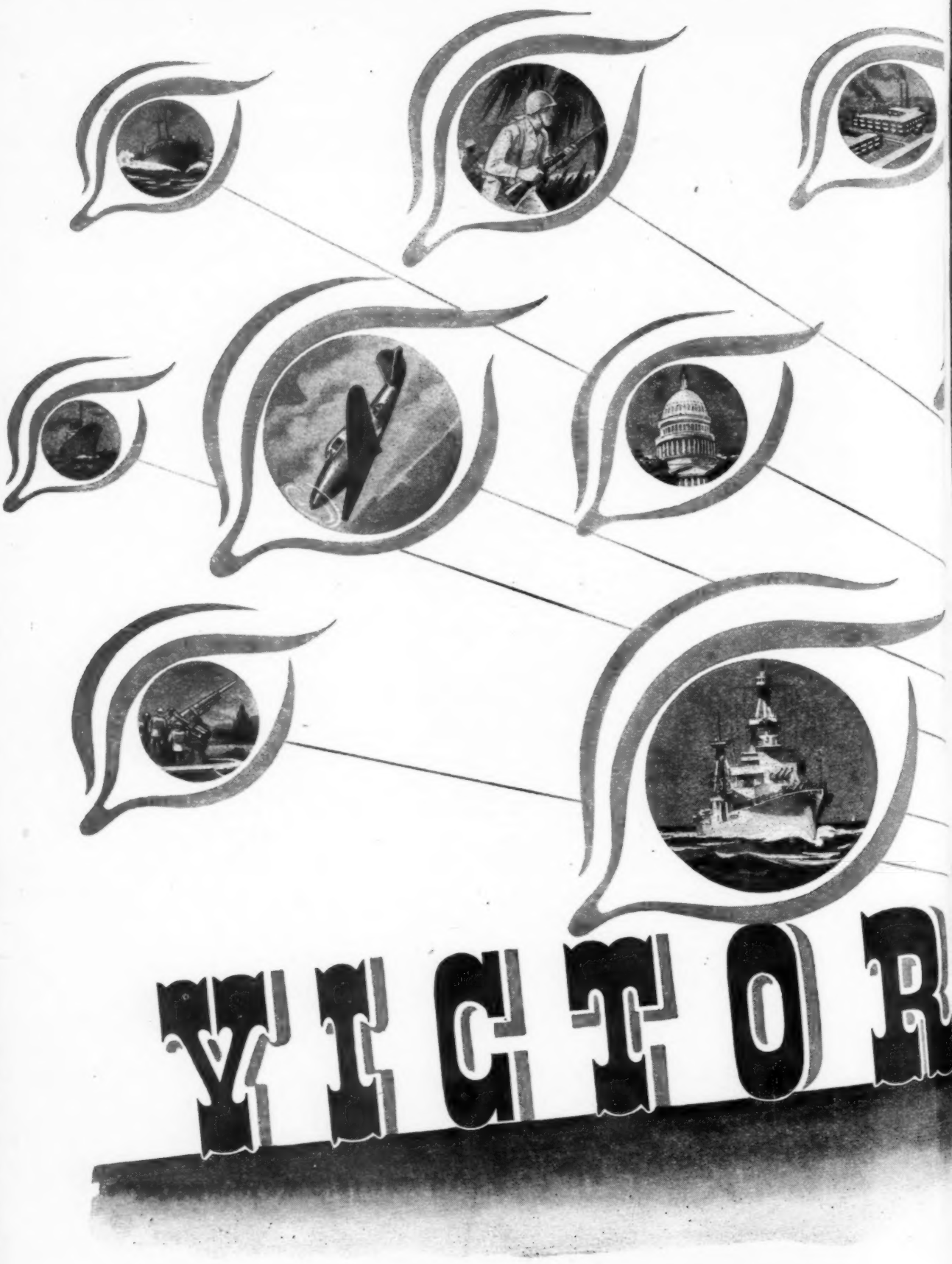
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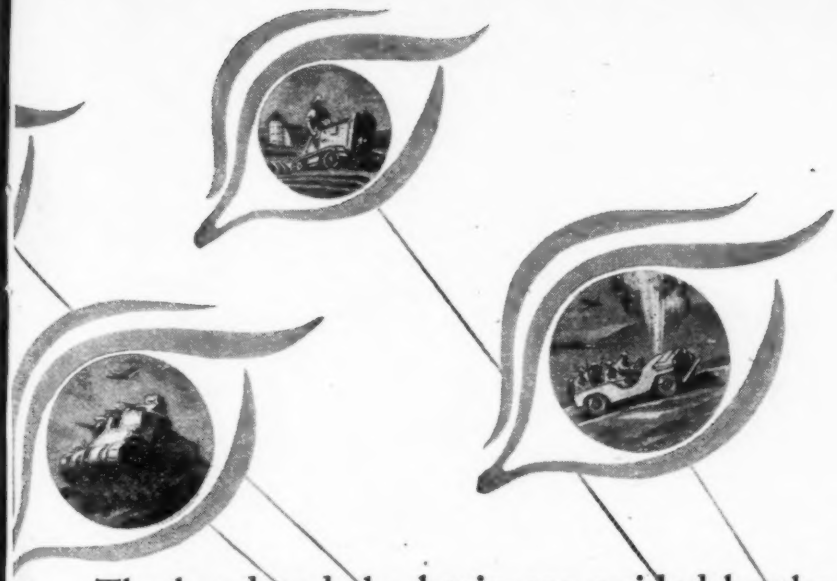

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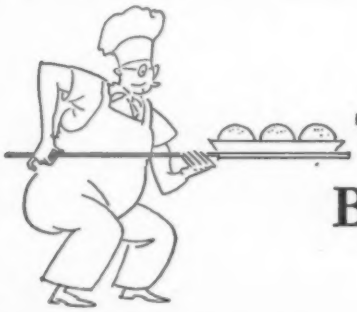

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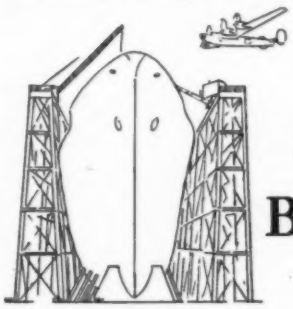

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VARIABLE FOCUS LENSES*

Robert Graham, A.B., B.Sc.
San Francisco, Calif.

The optical system of the vertebrate eye, including that of man, is made up of two main elements. These are a fixed-focus lens (the cornea) and an auxiliary lens of variable focus (the crystalline lens).

In designing lenses for his own external use, man has progressed brilliantly in the field of fixed-focus lenses. But he has not had a practical lens of variable focus. This is not, however, due to lack of attempts to produce one. Much ingenuity of a high order has been expended on the problem, for lens variability would be a great advantage in many situations. In ocular refraction, for example, one still must try lens after lens before the eye until a combination is found which neutralizes the ocular error. Ingenious phoroptors exist which greatly expedite such lens changes. But these are costly, and produce jumps in power, rather than a smooth progression.

Attempts to obtain variability have usually resulted either in complex optical systems or in impractical single lenses. Among the variable systems are the zooming-focus, and the oscillating focus devices used on cinema cameras; and the Clason Acuity Meter.

Apparently no serious attempt has been made to reproduce the vertebrate crystalline lens. Its structure is incredibly complicated, and its substance has never been synthesized. In fact, the whole thing is so complex that even today we are not exactly sure how it works—as the conflict between the accommodation theories of Helmholtz and Tscherning attests.

Probably the first attempts to produce a variable single lens were made by fastening two thin segments of glass spheres back to back in a frame, as shown in Fig. 1 A. The space enclosed by these shells was filled with a clear liquid, and the frame contracted to squeeze with a con-

---

*The author is manager of the Western Division of the Univis Lens Company, and member of the Optical Society of America. Submitted on June 19, 1942, for publication in the November issue of the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY.

stricting or sphincter-like action. This compressed the periphery of the shells, and altered the curvature of the refracting surfaces.[1]

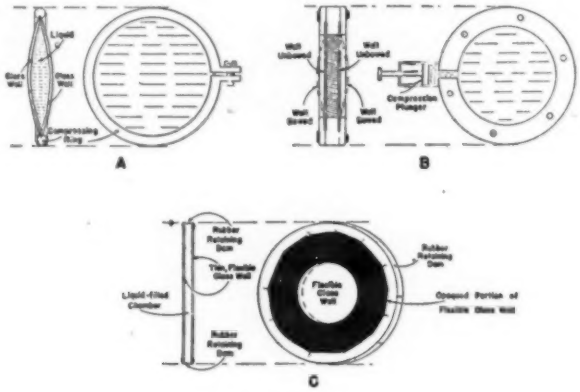

Fig. 1

Another common type brought about changes in the surface curvature by varying the internal pressure of the liquid filling a hollow lens, as is shown in Fig. 1 B. Pumping more liquid into the lens was supposed to increase its refracting power.[2]

Both of the above approaches attempt, however, to maintain a spherical surface while changing the radius of that surface. These two things cannot simultaneously be done without actually altering the surface area. In the absence of a suitably elastic and transparent material such attempts result in distortion of the lens surfaces.

Another approach was to place a globule of liquid of high surface tension (such as glycerine) in a tiny metal collar, or ring, less than one-quarter of an inch in diameter. Concave and convex meniscuses of different curvatures were formed as the amount of liquid was altered. A modification of this idea utilized a small hole drilled into, but not through, a plate of glass. The bottom of the hole was polished. By adding slightly more, or slightly less, glycerine than was required to completely fill the hole, a small convex or concave lens was formed.[3] But of course such lenses could be used in a horizontal position only, for in any other position gravity would cause the liquid surfaces to bulge asym-

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[1]H. Lauber, Arch. f. Ophth. (Leipzig 89-401 (1915). Gordon, Patent No. 269,422; 1918 (American).

[2]Ohmart, Patent No. 504,890; 1893 (American). Schaller, Patent No. 258,963; 1912 (German). Mitchell, Patent No. 258,325; 1925 (English).

[3]Pfleegor, Patent No. 1,521,563; 1924 (American).

metrically. And there was no means of producing any specific dioptric power at will.

DeZeng[4] invented in 1906 a variable lens consisting of two glass cylinders which were rotated in opposite directions about a common center. These cylinders were of equal but opposite powers. Hence when their meridians of maximum power were parallel the two neutralized each other, and the device produced no refractive effect. When they were crossed at right angles, the device produced its maximum plus power in one meridian, its maximum minus power in the opposite meridian. At intermediate positions the meridional difference increased as the crossing of the two cylinders approached a right angle. The difficulty with this device arose from the fact that a sphero-cylindrical combination was produced in which the spheric and cylindric components bore a definite relationship. In testing eyes the sphere and cylinder must be independent of each other.

In 1935 Luce[5] devised a variable liquid cylinder for magnifying advertising copy in one meridian only. This device consisted of an open, water-filled, cylindrical trough of sheet celluloid with soft rubber walls at its two ends. It was hardly an optical instrument, but it constituted the first variable liquid cylinder.

Almost simultaneously, and independently of each other, Ritzmann in Germany and Graham in the United States* developed mechanisms employing principles new to fluid lenses. These principles, common to both, are: 1. The curvature of a cylindrical segment (unlike a spherical one) may be altered without appreciably affecting its area, provided that the walls are thin and the moment properly applied. 2. A spherical refractive effect may be produced by crossing at right angles the axes of two like cylinders. For the first time, single lenses were made to produce spherical, cylindrical, or sphero-cylindrical effects at will, and in variable amounts.

The Ritzmann device applies torsion (twisting) to two opposite edges of a plane surface (such as a square of celluloid). This produces practically perfect cylinders, and an optically fine result. But the mechanism for applying this torsion is a large, unwieldly rack, without indicia to show the powers produced, or means for retaining said powers. The surfaces always spring back to plano unless held manually. It is purely a laboratory device, but one of considerable interest.[6]

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[4]DeZeng, Patent No. 886,770; 1908 (American).
[5]Luce, Patent No. 2,051,791; 1936 (American).
*At the Ohio State University.
[6]Ritzmann, Patent No. 628,774 (German).

Graham, on the other hand, produces his cylinders not by torsion, but by forcing two opposite edges of a plane surface slightly toward each other.[7] Plane surfaces, if square or rectangular in shape, become elliptical rather than cylindrical when flexed in this way. But by using circular or ellipsoid shapes, useful cylinders are formed when they are bent. This means of controlling the surface curvature lends itself to embodiment in a simple, compact mechanism, easy to operate and accurate in its results.* And it seems to have, because of its versatility, several practical applications.

The essential refracting unit, shown in Fig. 1 C, consists of two plane surfaces of glass, with clear liquid held between them by a rubber dam which joins the edges of the glass surfaces. This produces a short, wide-diameter tube of thin rubber with glass walls at its two ends. The space thus enclosed is filled with a liquid of suitable refractive index. The optimum thickness of the glass was found to be about 0.07 mm. Glass this thin is extremely flexible and hence is subject to little strain under moderate flexure. Irregular light transmission due to the partial polarization of light traversing glass under stress is therefore greatly reduced. One glass wall is flexed to form a segment of a cylinder. The other wall is similarly bowed, but in such a way that the axis of the second cylinder is at right angles to that of the first.

Two glass disks 34 mm. in diameter are used. Each of these is lightly clamped along opposed edges, as shown in Fig. 2 A and Fig. 2 D, and the bowing is accomplished by forcing the clamped edges slightly toward each other. The cylindrical lenses thus formed have a useful aperture of 18 mm. The remainder of the surface is rendered opaque.

The liquid is injected and the air withdrawn through the rubber wall of the completed unit by means of a hypodermic syringe. Liquids of low index require a greater variation in curvature to produce a given refractive change, and thus increase the accuracy of the mechanism. Liquids of higher index make possible a greater range of powers within a given elastic limit of glass. But although liquids are available with indices as high as 1.74 (methylene iodide), many of these are unstable and not sufficiently transparent. Distilled water is used because it is inert, and of suitable index.

Construction of the American Variable Focus Lens

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[7]Graham, Patent No. 2,269,905 (American).

*References—The Journal of the Optical Society of America, Vol. 30, No. 11, pp. 560-563. The Journal of Applied Physics, Vol. 13, No. 8, pp. 481-482.

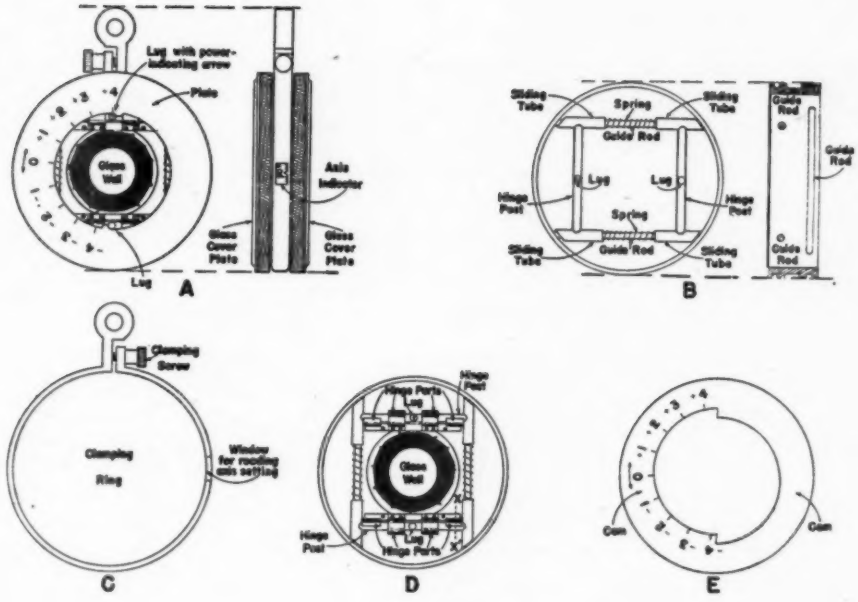

Fig. 2

The adhesive which holds the rubber to the glass walls is subject to little strain, since the liquid is not under pressure. A special type of non-drying gasket cement has proved successful for this purpose.

Such a refracting unit will last about a year whether in use or not. The rubber seems to deteriorate most where clamped against the glass. Since the walls are never stretched, syntheic rubber, being much less subject to deterioration, may be employed to increase the life of a unit indefinitely.

To select any dioptric power within the limits of the mechanism the circular plate of Fig. 2 A and Fig. 2 E is rotated until the desired number is opposite the fixed indicator arrow. In Fig. 2 A this arrow points to the plus 4.00-diopter mark. On the inside edges of this plate are cams which, when turned, force the lugs toward each other. The above mentioned indicating arrow is on the top of one of the lugs shown in Fig. 2 A and Fig. 2 D. The lugs, and the hinge-posts to which they are rigidly attached, may move laterally, as shown in Fig. 2 B. Any other movement is prevented by guide-rods along which slide small tubes attached rigidly to the ends of the hinge-posts. Small coiled springs maintain tension at all times on the moving parts, preventing all looseness and play which might cause inaccuracy.

The lugs transmit a pincerlike motion to opposite edges of the glass wall on Fig. 2 A and Fig. 2 D, through hinges put there to permit the edges of the glass wall to swing a small amount as the wall is bent. Thus the glass wall assumes the curvature appropriate to the power required. After the instrument is assembled, the cam plate is calibrated in diopters by placing the instrument in a vertex-dioptometer.

The opposite side of the device is identical to the side just described. However, the cylinder on this side is at right angles to the first, so that the axes of the two variable cylinders will be crossed.

The instrument is held by the ring shown in Fig. 2 C. Within this ring it may either be freely rotated, or clamped in any position. The position of one of the cylinder axes is indicated at all times by the figure read through a small window in the ring. See Fig. 2 A, side view, showing a setting of 90°.

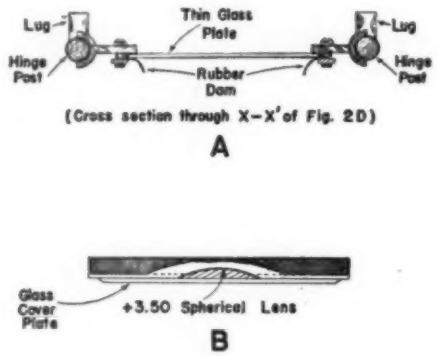

Fig. 3

Since it would be difficult, with this method of applying the moment, to cause the cylinder walls to bow either inwardly or outwardly at will, they are made to always bow inwardly by mounting them just off center with respect to the hinge-post shown in cross section in Fig. 3 A. This arrangement, then, produces minus powers only. In order that this variable focus lens may have both plus and minus powers, a common, fixed-focus, plus sphere of 3.50 diopters is cemented to the inside of one of the plane glass cover-plates, as shown in detail in Fig. 3 B. This gives a range of plus 3.50 diopters to minus 3.50 diopters in the first instrument made. A photograph of the variable focus lens is shown in Fig. 4.

As a variable spherical lens this device may find uses in cameras, so

that we may alter the focal length of the lens instead of changing the separation between lens and film, as at present.

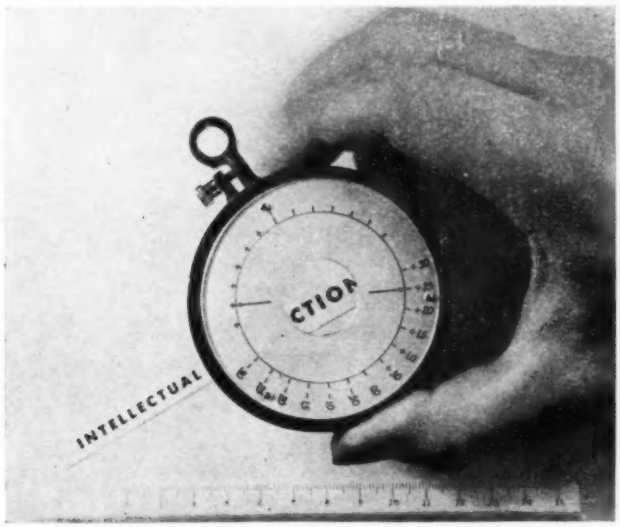

Fig. 4

In orthoptic or eye-training devices rotary prisms are frequently employed to gradually alter the amount of convergence of the two eyes while the accommodation remains constant. The variable lens now complements this practice by making it possible to induce gradual changes in the accommodation while the convergence remains constant.

The instrument here described was designed primarily for use in measuring errors of refraction of the eye. The ordinary way of measuring such errors is to try many lenses before the eye until a combination is found which neutralizes them.

With the variable focus lens it is now possible to smoothly vary the power of the lens before the eye so that there is no jump in power or interruption in the act of seeing. Since both spheres and cylinders are required in such work, this lens has been made to produce either spherical, cylindrical, or sphero-cylindrical powers.

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EFFECTS INDUCED BY ANISOMETROPIC CORRECTIONS*

V. Ellerbrock† and Glenn A. Fry
School of Optometry
Ohio State University
Columbus, Ohio

Introduction

Anisometropia requires for its correction the use of lenses which differ in power for the two eyes. This difference produces unequal prismatic effects in the peripheral parts of ordinary lenses.

One of the ways an anisometrope can overcome this prismatic inequality is by means of the fusional movements of his two eyes. Convergence and divergence would be called for in lateral excursions; positive and negative vertical divergence in vertical excursions. Positive vertical divergence is elicited by making the right eye turn higher than the left. Negative vertical divergence is just the opposite.

The range of fusional convergence and divergence is usually large and for this reason the prismatic inequality encountered in lateral excursions can cause little or no difficulty. The amplitude of positive and negative vertical divergence is usually very small and for this reason the prismatic inequality encountered in upward or downward gaze could conceivably call for the use of a large part of the total vertical divergence available. Since the eyes are used such a large part of the time turned down in the reading position, the present paper is largely confined to effects obtained at the reading level.

There are several ways in which lenses can be designed to compensate for the prismatic inequality at the reading level. One way to provide such compensation in a pair of lenses is to slab-off a prism segment from the lower part of one lens. This can be done in either single vision or bifocal lenses. Lenses of this type are referred to as compensated.

Lenses in which no attempt has been made to compensate for the

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*An abridgment of the material presented before the American Academy of Optometry, at Chicago, Illinois, December 8, 1941, for publication in the November, 1942, issue of the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY.

†Univis Lens Company Research Fellow.

prismatic inequalities at the reading level are referred to as uncompensated.

Besides utilizing the fusional movements, there are several ways in which the anisometrope can cope with the situation created by uncompensated lenses:

1. A tilting of the head toward the left or right shoulder which modifies the vertical balance of the two eyes.
2. A tilting of the head up or down so that the eyes do not have to look through the periphery of the lenses.
3. The movement of near work toward the less myopic or more hyperopic side.

Cusick and Hawn[1] have pointed out that it is not uncommon to find a patient who is wearing glasses with a 5.00 D. difference in the corrections of the two eyes and who has no measurable hyperphoria in straight ahead vision or at the reading level.

If this finding is typical of anisometropes, it must mean that they are able to change the relative position of rest of the two eyes in going from the straight forward position to the reading position, because at the reading level considerable inequality in the prismatic effects of the two lenses would have to be compensated.

In the present investigation an effort has been made to analyze the effects on vertical phorias and ductions induced by wearing uncompensated lenses and to determine if possible why an anisometrope is able to prevent hyperphoria from becoming manifest at the reading level.

Definition.

The arbitrary reference points and planes which were defined by Kehoe and Fry[2] in order to designate the position of a pair of lenses with respect to the head and the position of the lines of sight will be used in this report and are as follows:

1. The line of sight of each eye connects the point of fixation and the center of the entrance pupil.

2. The center of rotation represents the point around which the line of sight turns in changing its direction. When the line of sight is straight forward, the center of rotation may be assumed to lie on the line of sight 13 mm. behind the cornea.

3. The face plane is the plane which touches the chin and the two supercilliary ridges.

4. The primary horizontal plane of the head passes through the

centers of rotation of the two eyes, and is perpendicular to the face plane.

5. The base line connects the centers of rotation of the two eyes.

6. The primary sagittal line lies in the horizontal plane and is perpendicular to the base line at its midpoint.

7. The line of sight of either eye is said to be straight forward when it is parallel to the primary sagittal line.

8. The reading position of the lines of sight is represented by the angular deviation above or below the horizontal plane of the head when the individual is in his normal reading posture.

Methods and Procedure

The Source of Anisometropes

The anisometropes used in this investigation were secured either from those who went through the Ohio State University Optometric Clinic, or from various optometrists in central Ohio who referred patients to aid in this investigation.

All of the patients used in this investigation had a vertical anisometropia of at least 1.00 D.

Patients with an acuity less than 20/50 in one or both eyes have not been included in this report.

No limitations were placed on the size of the phorias at either distance or near but all cases were able to maintain single binocular vision.

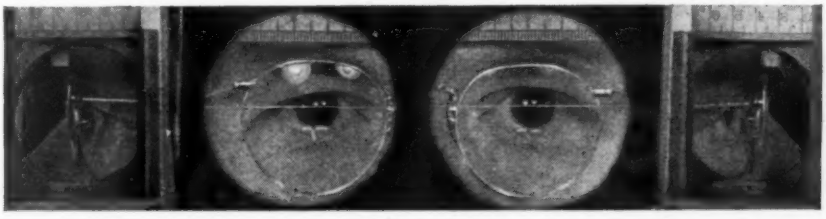
Stereotyped Procedure Which Was Carried Through For Each Patient

This procedure can be explained in terms of the two visits which each individual was required to make, and the exact procedure which was carried through during each visit.

During the first visit, a thorough test for squint by the corneal reflex and cover methods was made both at distance and at near. Assuming a negative result of these tests the patient's previous examination records were then carefully scrutinized in order to find out if there existed any pathology, or abnormal findings which might be serving as a source of difficulty to the patient. Assuming these findings were in order, the data such as the power, size, shape, and drilling points of the lenses the patient was wearing were then secured. The center thickness and the curvature of the front surface in the vertical and horizontal meridians were likewise measured and recorded.

While measuring the power of the lenses, the optical centers were marked. Small white dashes were placed surrounding this mark. Then while the patient was wearing the lenses, his photograph was taken with an instrument called a topometer.

The topometer has been fully described in the literature[3] and consequently a detailed description of it is not warranted in this report. Suffice it to state that it is an instrument designed for the photographic recording of the position of a pair of lenses mounted in front of the

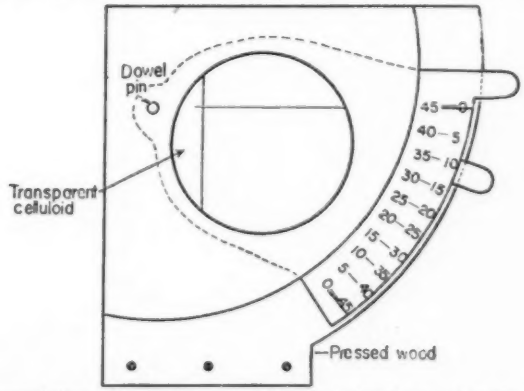


1. Photograph obtained with the topometer.

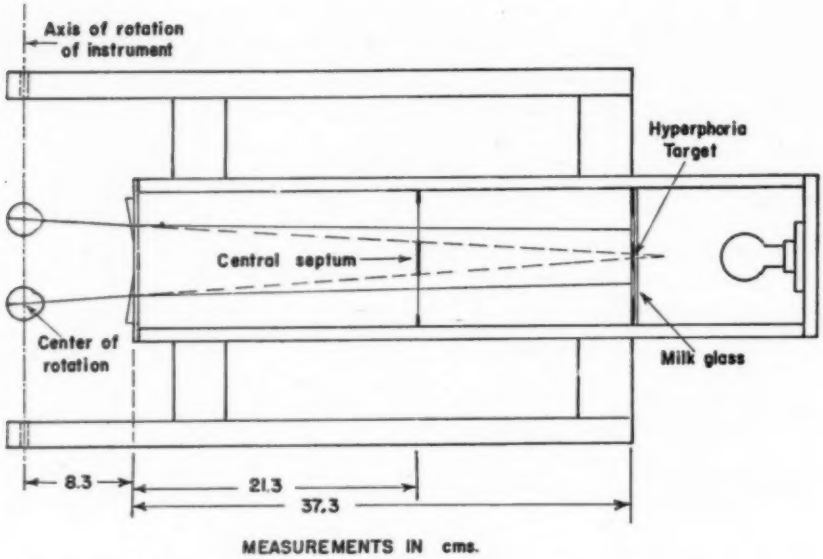
eyes. A typical photographic record is illustrated in Fig. 1. By virtue of the optical system, orthographic projection is obtained in both the front and the side views. The orthographic projection feature makes it possible to set the points of a pair of dividers corresponding to any pair of points in the front or side view photograph and then measure the distance by applying the dividers to the scale in the upper part of the photograph.

The instrument is provided with a chin rest and a forehead rest which keep the two eyes at the proper level and which also keep the chin and two superciliary ridges tangent to a vertical plane.

A special device was then used for measuring the reading position



2. Device for determining the reading position of the lines of sight.



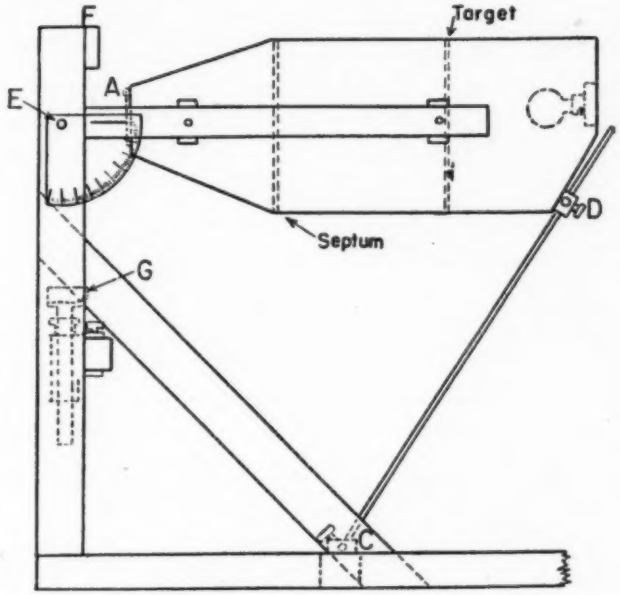
3. Top view of the hyperphoria measuring device.

of the lines of sight. This instrument consists essentially of two pieces of transparent celluloid, which rotate about a fixed dowel pin. On each piece of celluloid there is a long narrow line; on the one, a vertical; and on the second a horizontal line (Fig. 2).

The two pieces of celluloid are mounted between two pieces of pressed wood with a large opening at the center of each. This, in turn, is mounted on a table with the center of the opening approximately 48 inches from the floor. This height was chosen because it approximates the average eye level of adult individuals when sitting.

The procedure was to have the patient sit sidewise about 4 feet in front of the instrument. He was instructed to hold the reading material which was given him in his normal reading position. The operator would place himself on the opposite side of the instrument and line up the vertical line with the patient's eyebrow and chin, and then the horizontal line with the center of rotation of the eye and the center of a small paragraph of reading material the patient was reading. The tilt of the face plane from the vertical and the depression of the line of sight below the horizontal plane of the head could then be read directly from the scales.

The scale for the vertical line is fixed with respect to the instrument. The scale for the horizontal line is marked on the piece of celluloid carrying the vertical line. Consequently, for each position of the vertical



4. Side view of the hyperphoria measuring device.

line, the zero position of the horizontal line is always perpendicular to the vertical. Hence, when the vertical line is lined up with the face plane the zero position of the horizontal line corresponds to the horizontal plane of the head.

Five separate determinations of the depression of the line of sight were made for each patient and the average was taken as representative of the patient's habitual reading position. The measurements were usually made with the patient seated in a straight chair, but he was seated at a desk when most of his near work was of this type.

The patient was then dismissed and told that he would be asked to report again in approximately two weeks.

At the second visit, while the patient was wearing his uncompensated lenses, the phorias, ductions and acuities were measured with a special device, which has been described in detail elsewhere.[4]

This instrument is essentially a Brewster type stereoscope in which a Steven's phorometer is substituted for the prism lenses. The targets are so designed that the images of the two halves of each target are exactly superimposed when the prism bases are directed outward. Fig. 3 shows a top view of the instrument illustrating the optical principles.

The prisms are synchronized to rotate simultaneously in the same

direction. This adds base-up component in one and a base-down component in the other without appreciable decrease in the base-out component as long as the vertical component is small.

Dissociation is obtained by means of a 2 cm. central vertical septum placed 24 cm. from the plane of the prisms. This septum occludes the right half of the test target from the left eye and the left half of the target from the right eye.

A slot for the test targets is provided at a distance of 37.3 cm. from the plane of the prisms. These targets are translucent and are illuminated from the rear by a 25-watt bulb.

The side view of the instrument in Fig. 4 illustrates the method used to rotate the instrument about a fixed axis at the point E. D is a clamping device which moves on the rod supporting the instrument. At E is a celluloid scale calibrated in half degrees from which various positions of the instrument can be determined. The horizontal position is arbitrarily defined as the zero position and the other positions as angular deviations above or below this position.

The rear surface of the head rest (F) and the chin rest (G) are in the same vertical plane. This prevents the head from pitching forward or backward and keeps the eyes at a fixed distance from the instrument. The chin rest can be adjusted up and down in order to place the centers of the rotation of the eyes at the same level as the axis of rotation of the instrument.

The targets used for measuring the vertical phoria consist of two vertical rectangular openings side by side in a piece of black cardboard. These openings are separated by a distance of 2 cm., so that the septum occludes the left opening from the right eye and the right opening from the left eye. Bisecting each of these openings, on a piece of milk glass in contact with the back surface of the cardboard, a vertical black line was drawn to assist the subject in retaining horizontal binocular fixation. On the left side of the vertical line and midway between the top and bottom of the opening is a horizontal arrow with its head toward the black line. A vertical scale, graduated in quarter prism diopters of deviation above and below a zero point on the same level as the arrow head, is located within the right opening on the right side of the vertical line. Thus, the arrow can be made to slide up and down the vertical scale in the binocular image by turning the prisms. When the prisms are adjusted to make the arrow fall at zero, the position of the prisms is a measure of the vertical phoria. The prisms are calibrated in terms of effective

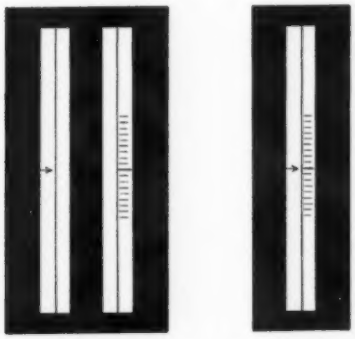


Fig. 4a PHORIA PATTERN PATTERN PATIENT OBSERVES

power at the centers of rotation of the eyes. The subject can estimate the apparent position of the arrow to the nearest .1△ on the scale (Fig. 4a).

Not only can the instrument be utilized for an accurate measure of the vertical phoria but it can likewise be adapted to the measurement of vertical ductions and visual acuity. The duction pattern consists of a pair of 2.5 x 2 cm. rectangular openings placed side by side in a piece of blank cardboard. In the center of each aperture is a black horizontal line 1 cm. long painted on a piece of white paper which covers the openings. By turning the prisms from their zero position the fused single image of the lines is made to double. The phorometer scale reading is a measure of the break point (Fig. 4b).

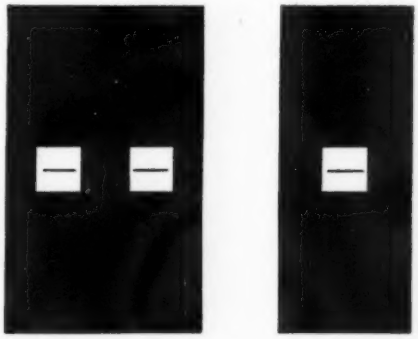


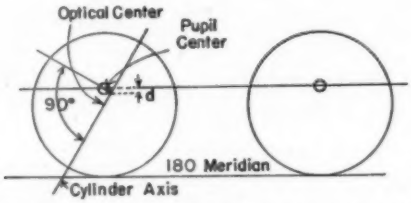
Fig. 4b Vertical duction pattern Duction pattern as seen by patient

To obtain a measure of the visual acuity the phorometer which is mounted by hinges may be swung upward and out of the way. The septum can then be removed and a reduced Snellen pattern, photographically printed on white paper and mounted in an aperture in a piece

of black cardboard, may then be inserted in the target slot. The smallest readable line is a measure of the visual acuity.

The sequence of the phoria duction and acuity tests was as follows: First, the phoria at the straight forward position was measured, and without the individual moving his head with respect to the instrument, the phoria at the average reading position was measured. The time to make these two measurements rarely exceeded one minute. The base-down and up O.D. ductions were then measured at the reading position, followed by similar measurements at the straight forward position. The visual acuity subsequently was measured for O.D., O.S. and O.U. first at the straight forward position and immediately following at the reading position.

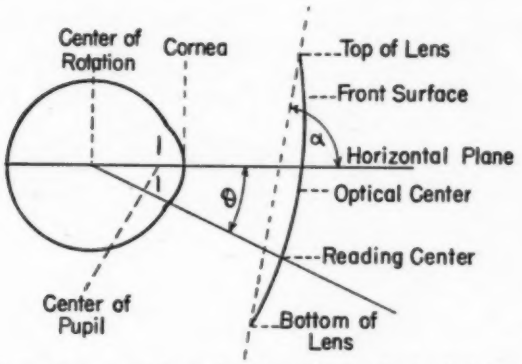
In those cases in which the value for the angle theta was less than 18°, the value for the depression of the line of sight was arbitrarily increased in making phoria, duction and acuity measurements.



5. Diagram showing the method of computing the prismatic effects encountered in straight ahead vision.

In order to evaluate properly the phoria and duction findings at the straight forward and reading positions, it was necessary to compute the prismatic effects at the straight forward and reading positions.

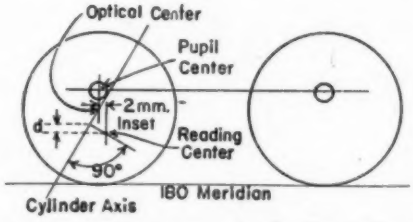
From the data secured at the first visit, it was possible to determine the points on the lens surfaces penetrated by the straight forward and reading positions of the line of sight[5, 6]. The front views in the topometer photograph give the position of the optical centers of the lenses with respect to the pupil centers as shown in Fig. 5. The line connecting the bottoms of the lenses was taken as equivalent to the 180 meridian of the spectacles and was used in locating the cylinder axes. The vertical prismatic effects at the point corresponding to the center of each pupil were computed by separately determining the prismatic effects for the sphere and cylinder components. The prismatic effect of the sphere was computed by multiplying the power of the sphere by the distance in cm. from the optical center to the level of the center of the pupil. The



6. Sectional drawing of eye and lens showing the method of determining the distance of the reading center below the level of the pupils.

power due to the cylinder component was computed by erecting a perpendicular line from the center of the pupil to the cylinder axis, and measuring the distance from the optical center to the level of this intersection and multiplying this distance in cm. by the power of the cylinder.

From the data obtained relative to the depression of the reading position line of sight and the position of the lens in front of the eye, it is possible to draw a sectional view of the eye and lens as shown in Fig. 6 and then measure directly the distance from the horizontal plane to the point penetrated by the reading position of the line of sight. In locating this point in a front view diagram of the lens (see Fig. 7), it



7. Diagram showing the method of determining the prismatic effect encountered at the reading centers.

is assumed that it is decentered 2 mm. nasalward from the center of the pupil. The vertical prismatic effect at this point is computed in a similar manner as the vertical prismatic effect at the straight forward position.

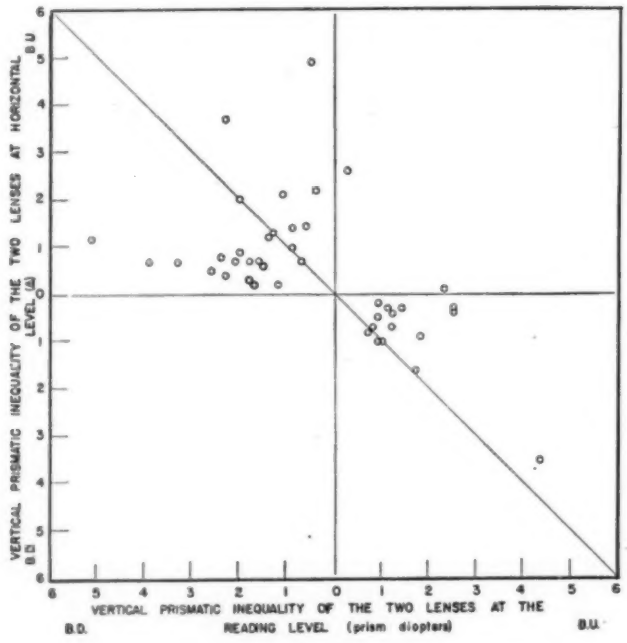
After having computed the prismatic effects in the separate lenses, the inequalities between the prismatic effects of the two lenses at the reading or straight ahead position can be ascertained simply by combining the prismatic effects of the two lenses.

The gross phoria findings obtained at the straight ahead and

reading positions incorporate the prismatic inequalities of the two lenses. The net phoria finding which is referred to frequently in subsequent parts of this report, is computed by deducting from the gross vertical phorias an allowance which represents the combined vertical prismatic effect induced by the two lenses. In other words, the net phoria represents the measurement that would be obtained if the lenses were free from prismatic effects.

The Analysis of the Phoria and Duction Measurements

Except in three cases, the lenses were so adjusted as to make the optical centers fall between the straight forward and the reading positions of the lines of sight. Since this is true, the combined prismatic effects at the two positions were usually opposite in type, being base-up O.D. at one position and base-down O.D. at the other. This is shown in Fig. 8.

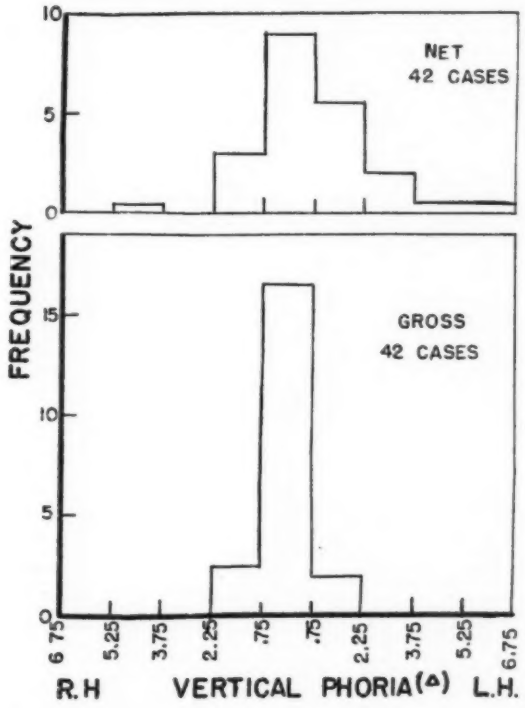

VERTICAL PRISMATIC INEQUALITY OF THE TWO LENSES AT HORIZONTAL LEVEL (Δ)
B.U.
B.D.
6 5 4 3 2 1 0 1 2 3 4 5 6
VERTICAL PRISMATIC INEQUALITY OF THE TWO LENSES AT THE READING LEVEL (prism diopters)
B.D.
B.U.

8. Comparison of the prismatic inequalities at the straight forward and reading positions.

The question arises as to how an anisometrope adjusts himself to this situation. In a group of non-anisometropes, hyperphoria is seldom found. On the assumption that anisometropes are also basically free from

any tendency toward hyperphoria, one might expect to find that the prism required to correct any measurable hyperphoria at either the straight ahead position or at the reading level merely compensates the inequality between the vertical prismatic effects of the two lenses. In other words, the net vertical phoria should be approximately zero at all levels.

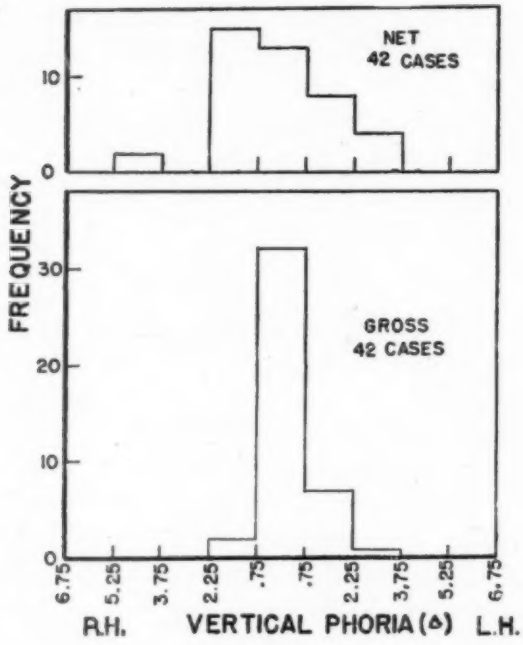
However, if the anisometrope could alter his position of rest to compensate the prismatic effects in the lenses, the net phorias would be expected to vary from zero by an amount equivalent to the prismatic inequality of the lenses, and the gross phorias would therefore be expected to approach zero.



9. Comparison of the frequency distributions of gross and net phorias at the horizontal level.

Fig. 9 shows that at the straight forward position the frequency distribution of gross phorias is much more concentrated around the zero point than the net phorias. This indicates that anisometropes are able

to alter the position of rest to compensate the unequal prismatic effects. Fig. 10 shows a similar situation at the reading level.

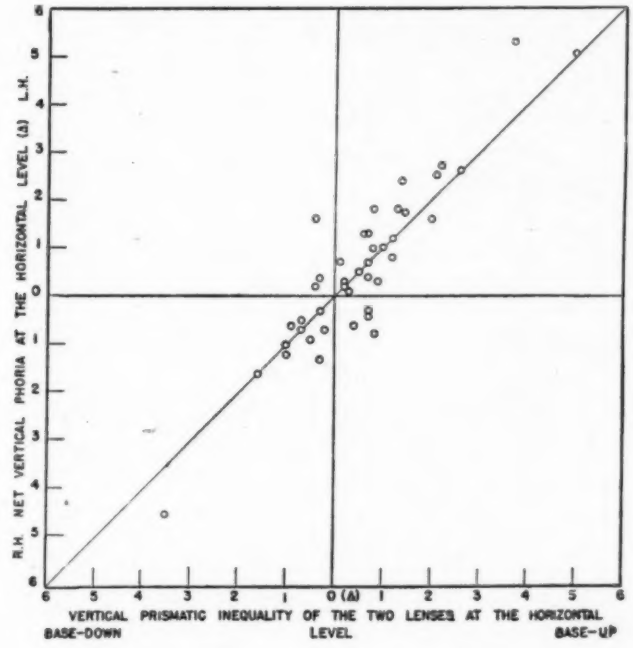


10. Comparison of the frequency distributions of gross and net phorias at the reading level.

The extent to which anisometropes are able to alter their positions of rest to compensate for unequal prismatic effects can be shown by comparing the net phoria with the combined prismatic effect of the two lenses. The data for the straight forward and reading positions are shown in Figs. 11 and 12. These show that the compensation made by the eyes is almost complete at each level.

This is true in spite of the fact that in cases with small reading depths, the phorias at the reading level were measured with the instrument set at a much lower level than that corresponding to the usual reading depth. Since the phoria measurements were made at the increased reading depth, rather than that normally assumed by the patient, it is conceivable that the eyes might not have made complete compensation for the prismatic inequality at this arbitrarily chosen level. This was

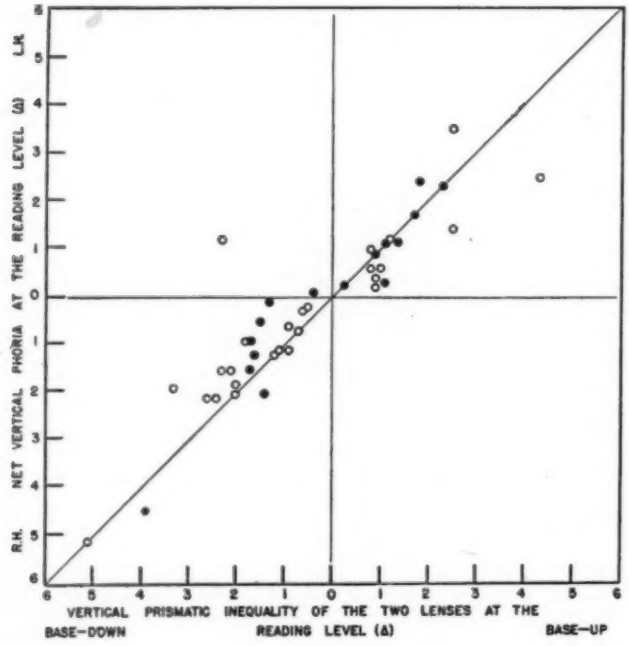
proven not to be the case by filling in solid the circles in Fig. 12 which represent the cases with arbitrarily increased reading depths. These cases show just as complete a compensation as the rest.


R.H. NET VERTICAL PHORIA AT THE HORIZONTAL LEVEL (Δ) L.H.
VERTICAL PRISMATIC INEQUALITY OF THE TWO LENSES AT THE HORIZONTAL LEVEL
BASE-DOWN
BASE-UP
0 (Δ)

11. Relation of net phorias to prismatic inequalities at the horizontal level.

Special attention should be called to the fact that anisometropes make different types of compensation at the straight forward and reading levels. This is illustrated in the way in which the net vertical phoria at the horizontal level is plotted against the net vertical phoria at the reading level. The fact that the cases are concentrated in the second and the fourth quadrants indicates that in general opposite types of compensatory adjustments are found at the two levels.

The important question arises as to whether this ability to make one kind of adjustment at the reading level and another type of adjustment at the horizontal level represents an alternation between two "all-or-none" adjustments associated with reading and walking, or whether this adjusting process varies continuously from one level to another. The only factual evidence bearing on this point is found in the data for the


R.H. NET VERTICAL PHORIA AT THE READING LEVEL (Δ) L.H.
VERTICAL PRISMATIC INEQUALITY OF THE TWO LENSES AT THE READING LEVEL (Δ)
BASE-DOWN
BASE-UP

12. Relation of net phorias to prismatic inequalities at the reading level. The solid circles represent the cases in which the phoria at the reading level was made at a greater depth than that which the patient was accustomed to.

group of anisometropes in which the reading depth was arbitrarily increased over the habitual reading depth when making the phoria measurements. In spite of the fact that the measurements were made at a much lower level than the customary reading position, the eyes showed just as complete compensation at this lower level as the remaining anisometropes showed at their habitual reading level. These results indicate that the adjusting process varies continuously over the visual field.

The question might now be considered whether this capacity for differential adjustment of the position of rest at various levels is related to the fusion mechanism of the eyes. It might be supposed, for example, that if a person were wearing a minus lens over the right eye and a plano lens over the left eye, and if he were instructed to look at an object straight ahead, the right eye might automatically make a subductive movement to overcome the base-down effect in the upper part of the minus lens; and if he were instructed to change to an object at the reading level, the right eye would automatically switch over from a sub-

ductive to a supraductive movement. If the compensatory adjustments which the eyes make in switching from one level to another do actually involve a manipulation of the vertical fusion mechanism, as described above, one would expect the limits of the duction range to remain relatively stable in switching from the straight ahead to the reading position, but the phoria would switch from one side to the other of the midpoint of the duction range. The possibility of this happening can be tested by comparing the phoria finding with the midpoint of the duction range. Although the net phoria findings vary over quite a wide range as compared with each other they seldom deviate to any great extent from the midpoint of the duction range.

This type of data gives evidence, therefore, that the compensatory adjustments in the position of rest do not involve the use of the vertical fusion mechanism whose limits can be measured by determining the tolerance for prism base-up and base-down.

Conclusions

The following conclusions can be drawn from this investigation:

(1) The anisometrope develops a capacity for compensating prismatic inequalities at the straight forward and the reading positions. This is demonstrated by the fact that the gross phoria is found to be approximately zero at both positions.

(2) There is certain evidence that these compensatory adjustments vary continuously from one part of the field of fixation to another.

(3) As the phorias become adjusted to the prismatic inequality at the two positions, the midpoint of the duction range shifts accordingly.

REFERENCES

1. Cusick, P. L., and Hawn, H. W., *Prism Compensation in Cases of Anisometropia,* Arch. of Ophth., Vol. 25, pp. 651-654 (1941).
2. Kehoe, J. C., *An Investigation of the Effects of Vertical Imbalance at the Reading Level in Cases of Anisometropia.* M.Sc. Thesis, The Ohio State University, 1940.
3. Fry, G. A., and Kehoe, J. C., *An Instrument for Photographic Recording of the Position of a Pair of Lenses Mounted in Front of the Eyes.* Am. Jour. of Opt., Vol. 17, pp. 502-510 (1940).
4. Ellerbrock, V., *An Instrument for Measuring Head and Eye Posture.* To be published.
5. Kehoe, J. C., and Fry, G. A., *An Empirical Method of Determining the Vertical Prismatic Effect at the Reading Center of a Lens.* Am. Jour. of Opt., Vol. 17, pp. 543-551 (1940).
6. Ellerbrock, V., and Fry, G. A., *Accuracy in Determining the Reading Depth.* Am. Jour. of Opt., Vol. 18, pp. 258-269 (1941).

MONOCULAR ACCOMMODATION

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It has been assumed in Physiological Optics that innervation to accommodation is bilaterally symmetrical, and that any change in ocular refractive power in the interest of clear binocular vision occurs to the same degree in each eye.

In the course of investigating various binocular visual phenomena by haploscope methods, it became evident that under certain visual conditions accommodation might not be equally represented in each eye. As far as the authors have been able to determine there is only a single reference concerning this subject in the literature. This is a reference in which Duke-Elder[1] quotes Hess and Newmann, who state that it is possible in the normal individual to compensate for a difference in refraction between two eyes of only 0.12 diopter. Such compensation is a unilateral or monocular accommodation. This result, therefore, tends to substantiate the statement that accommodation is essentially bilaterally symmetrical.

In view of its importance both theoretically and clinically in its bearing upon binocular refractive balance and innervation to the ciliary body which controls accommodation, it seemed desirable to investigate further the possibility of monocular accommodation on a quantitative basis.

The experimental investigation of this problem is most easily performed upon the haploscope, with which the actual refractive power of each eye may be measured to any predetermined degree of accuracy while the subject performs a specified visual task. The principle of the haploscope is represented in Figure 1.

In Figure 1, M_1 and M_2 are half silvered mirrors, and L_1 and L_2 are collimating lenses for the point sources of light S_1 and S_2. R_1 and R_2 are corrective refractive lenses, and O is the object fixated binocularly.

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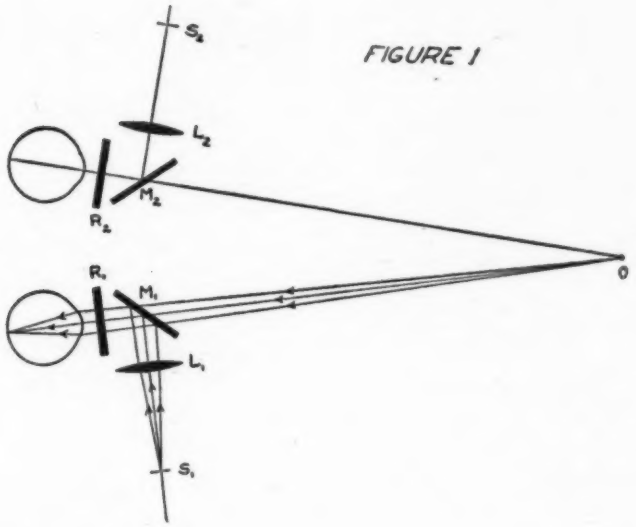


FIGURE 1

THE HAPLOSCOPE

With the haploscope used in this investigation, S_1 and S_2 consisted of round apertures 0.05 mm. in diameter in aluminum foil illuminated from behind. Lenses L_1 and L_2 were 10 diopter achromats. The object O consisted of 20/20 reduced Snellen characters printed upon a white cardboard background 40 cm. distant from a plane 13 mm. in front of the anterior corneal surface.

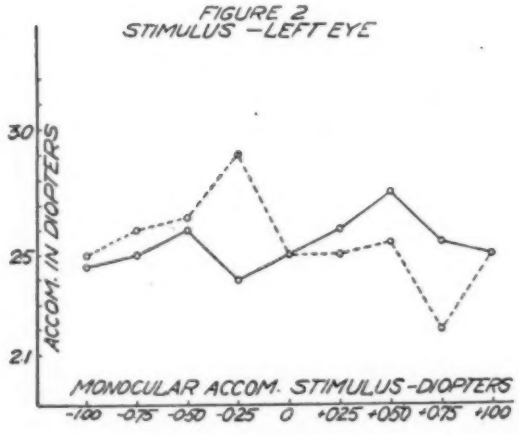
In using the haploscope for this experiment the subject viewed the object O binocularly. While this was being done the point optically conjugate to the fovea of each eye was determined subjectively by moving the point sources of light S_1 and S_2 along the respective haploscope arms until they appeared smallest. It is important that clear perception of the object O be maintained while this is being done. From the positions of S_1 and S_2 relative to the lenses L_1 and L_2 and the positions of the eyes relative to the optical components of the haploscope, it is possible to calculate the refractive power of each eye. Repeated subjective measurements of the points conjugate to the fovea of each eye by repeating the above procedure resulted in a series of values that could be averaged statistically, thus measuring the refractive power of each eye to any desired accuracy.

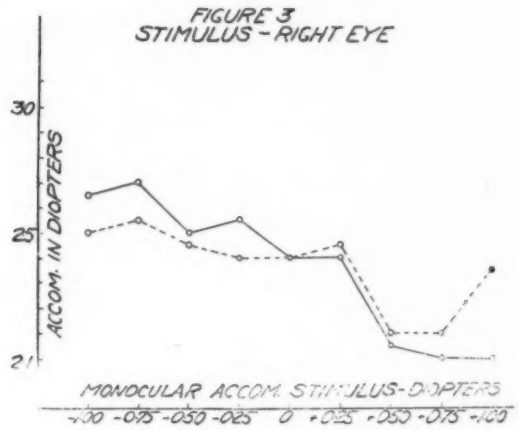
For the present problem, that of measuring any possible monocular accommodation, or monocular change in refractive state, the haploscope procedure is presented in the following paragraph.

After a careful preliminary refractive examination with particular emphasis upon the refractive balance between the two eyes, the refractive correction lenses were placed in the lens cells of the haploscope. The actual subjective refractive state of each eye was then determined haploscopically as outlined above. The measurements were repeated a number of times; the exact number of determinations depending upon the repetition of the measurements. On an average five determinations sufficed for each eye.

Following this a —0.25 D.S. lens was placed before the right eye and the above measurements repeated. The —0.25 D.S. lens was then placed before the left eye and the refractive state of each eye was again determined. This was repeated for lenses of +0.25 D., ±0.50 D., ±0.75 D., ±1.00 D. placed monocularly before each eye, with the determination of the refractive state of each eye for each added lens while binocular fixation of object O was maintained. For most subjects the monocular addition of ±1.00 D.S. resulted in considerable ocular rivalry and for some subjects ±0.75 D.S. added monocularly also caused ocular rivalry. This indicated a monocular accommodation insufficient to compensate for the added lens. No ocular rivalry resulted from monocular additions of ±0.25 D.S. and ±0.50 D.S.

The results of these measurements upon a number of subjects are illustrated graphically in Figures 2 to 4. In these graphs the ordinates





indicate actual accommodation for each eye as measured upon the haploscope, and the abscissae indicate the monocular accommodative stimuli in diopters. It should be noted that the accommodative stimulus to the eye not having the added lens was presumably 2.5 D. Occasionally for binocular fixation at 40 cm. with no added lenses the refractive state of the two eyes deviated from 2.5 D. In such cases in graphical representation the refractive states were arbitrarily reduced to 2.5 D. for the 2.5 D. accommodative stimuli.

These graphical results show that it is possible to have a monocular accommodation. In all cases the monocular accommodative stimulus results in a monocular accommodation less than the stimulus. There also appears to be a maximum limit to monocular accommodation for a given subject. In some subjects, when demand is made, monocular accommodation may occasionally reach 0.50 D. relative to the refractive state of the other eye; in other subjects 0.25 D. may be considered to be the upper limit to monocular accommodation.

It can be seen from the graphical data that no uniform relationship, other than a rough general one, exists between monocular accommodation and the monocular accommodative stimulus. While findings for a given subject are repeated at a given examination, slight differences may be found at a subsequent examination.

Certain other characteristics of monocular accommodation result

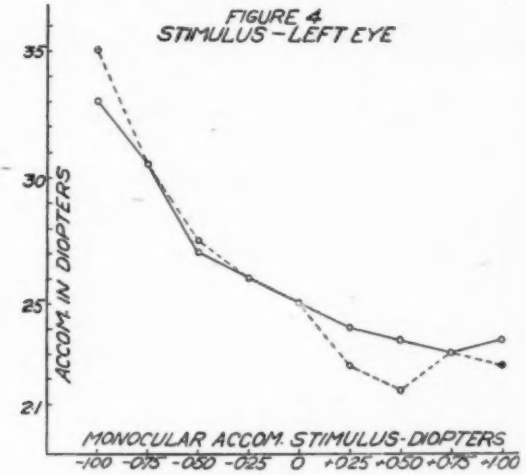
from these measurements. If, for example, the accommodative stimulus to the right eye is 3.50 D. and that to the left eye is 2.50 D., three possible results may occur in various subjects. Under the above circumstances the right eye may accommodate consensually with, in general, a slightly lesser degree of accommodation; or, neither eye may accommodate materially more than 2.50 D. (for 40 cm. fixation) in spite of the larger monocular accommodative stimulus presented to one eye; or, each eye may accommodate such that the refractive state of each eye falls approximately half way between the two monocular accommodative stimuli. In the latter case, the most probable one, each eye would exhibit an accommodation approximately 3.0 D. One of these above responses may occur for accommodative stimuli presented to the right eye and another type for accommodative stimuli presented to the left eye. Such differences are consistent for a given subject. It was felt at first that there might be some connection between such differences and eye dominancy, but the correlation, if any, is poor.

TABLE 1

Monocular Accom. Stimulus	+1.00 D	+0.75 D	+0.50 D	+0.25 D	0.00 D	—0.25 D	—0.50 D	—0.75 D	—1.00 D
Monocular Accommodation	0.14 D	0.10 D	0.10 D	0.11 D	0.00 D	0.13 D	0.14 D	0.16 D	0.15 D

In Table 1, is recorded the *average* value for the monocular accommodation for each monocular accommodative stimulus. These are averages resulting from seventeen sets of data. While these *average* values do not deviate significantly numerically from the results of Hess and Neumann as recorded by Duke-Elder, there is an essential difference between the two results. Hess and Neumann indicate that the monocular accommodative amplitude does not exceed 0.12 D. while this investigation shows that this amplitude can in individual cases reach 0.50 D.

The results of this investigation may be summarized as follows: Monocular accommodation occurs in various subjects when a monocular



accommodative stimulus is presented to eyes performing a binocular visual task. The amount of monocular accommodation varies roughly with the magnitude of the accommodative stimulus presented and for a given subject. In general, the maximum amount of monocular accommodation for any monocular accommodative stimulus rarely exceeds 0.50 D. On an average it has an approximate value of 0.12 D. for all monocular accommodative stimuli between ±0.25 D. and ±1.00 D.

REFERENCES

1. Duke-Elder, Sir W. Stewart. Textbook of Ophthalmology, 1932, v. 1, p. 760.

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"VISUAL MECHANISMS"

A REVIEW AND AN APPRECIATION OF THE LECTURES ON VISION GIVEN AT THE SESQUICENTENNIAL ANNIVERSARY OF THE UNIVERSITY OF CHICAGO

I am very much interested in the new volume, Visual Mechanisms[1], for a very personal reason. It so happened that exactly a year ago today (September 24, 1941) I sat within the classic shades of the University of Chicago and heard the presentation of the eight papers that constituted the day's program on "Visual Mechanisms" on the occasion of the celebration of the Fiftieth Anniversary of the University of Chicago. In retrospect, I can say that it would be a grand privilege to be again in

[1]Visual Mechanisms. Edited by Dr. Heinrich Klüver. Being Volume VII of Biological Symposia. 322 pages .The Jaques Cattell Press, Lancaster, Pa. Price $3.25.

attendance at such a day's session concerning vision and even a greater privilege and pleasure to be permitted to sit, during the midday intermission, at the round table at the Faculty Club with the group of men who are contributors to this volume. As a much revered college professor in physics often said to us: "Well, it is time to return to the crow: but—we have had a grand good side excursion," so I can say that the "crow" was great but the side-trips and the comradeship and healthy discussion for an hour or better was greater. Then, on the following day, when my fancy took me into an entirely different realm of thought and activity in that week's offerings, Dame Fortune guided me and my colleagues to luncheon in Judson Hall, to sit opposite Mr. Jaques Cattell and his greatly respected and eminent father of eighty-two years, Dr. J. McKeen Cattell. As we visited together I asked their consideration of a volume to give to all of us interested in vision not only the eight papers of the day but also some additional or supplementary contributions concerning visual mechanisms. So the reader is now aware of my very great personal interest in this volume and the inner joy afforded me to be able to sit down and read and peruse these contributions by outstanding workers in the field of vision from various biophysical, biochemical, physiological, anatomical, psychological, ophthalmological and neurophysiological standpoints.

Such a book cannot be reviewed. Each individual contribution is a condensation of the results of research in the specified field of vision. The volume opens with an article of twenty pages on "Energy Relations in Vision" by Professor Selig Hecht. He made his presentation in Chicago concerning his direct measurements of the minimum energy required for vision, with values between 2.2 and 5.7 x 10^{-10} ergs (corresponding to between 58 and 148 quanta of blue-green light) at the cornea, and so on through his research to the conclusion that, "in order to produce a visual effect one quantum must be absorbed by each of 5 to 14 rods in the retina." I am sure we were much impressed, but—all of us were charmed with his use of the Poisson probability distribution to show that the "number of critical events involved at the threshold of vision is 5 to 7." And in his introduction he takes us back to the work of that great American pioneer scientist, Langley, of the Smithsonian Institute.

There are two men amongst many workers whose contributions on the photochemistry of visual purple and the vitamin A are outstanding. Citing them in the order of presentation of material in this volume, they are Dr. A. C. Krause of the University of Chicago and Dr. George

Wald of Harvard University. In their papers are to be found the latest work on the photosensitive substances of the retina, formation of visual purple, decomposition of visual purple (with provisual red, visual red, visual yellow), the rhodopsin system, the porphyropsin system, retinenes and vitamins A and so forth.

The paper by Dr. E. Gellhorn of the University of Illinois on "Anoxia in Relation to the Visual System" and the rather brief yet adequate bibliography will be of particular interest in these days of increased interest in aero-medical problems. The diminution of various visual functions, disturbances of voluntary eye movements during reading and similar effects of anoxia are discussed.

The succeeding 100 pages (pages 87-192) are devoted to four contributions of a neuro-physiological character. The titles are "Visual Sensation and Its Dependence on the Neuro-physiology of the Optic Pathway," by Dr. S. H. Bartley, Washington University School of Medicine; "Alpha Waves in Relation to Structures Involved in Vision," by Dr. T. J. Case, Division of Psychiatry, University of Chicago; "Recent Evidence for Neural Mechanisms in Vision Leading to a General Theory of Sensory Acuity," by Drs. W. H. Marshall and S. A. Talbot, Laboratory of Physiological Optics, Wilmer Institute of Johns Hopkins University, and "The Functional Organization of the Occipital Lobe," by Drs. von Bonin, Garol and McCulloch of the University of Illinois and of Yale University. Scattered through these pages are many valuable and illuminating paragraphs on neural summation, local neural factors in acuity, wider neural factors in acuity, neural factors in fusion and binocular acuity, neuro-sensory correlations, neurophysiology and phenomena arising from relational activity. Here are neurological phases of vision adequately treated by scientifically trained neurologists as contradistinguished from much constipation of ideas and diarrhoea of words from lecturers of certain groups of practitioners and from certain types of psychologists.

The anatomy of the retina is very briefly treated by Professor S. L. Polyak of the University of Chicago. At the conclusion he makes reference to his own comprehensive treatise, "The Retina," published by the University. From the anatomical standpoint, the outstanding contribution is by Dr. G. L. Walls of the Ophthalmic Research Laboratory of Wayne University College of Medicine, Detroit. This chapter of fifty pages simply serves as a wetter of the appetite for Wells' "arbeit" on "The Vertebrate Eye and Its Adaptive Radiation" just issued by the Cranbrook Institute of Science.

The concluding chapters of the volume are by Dr. H. Klüver, Professor of Experimental Psychology of the Sprague Memorial Institute of the University of Chicago and by Professor K. S. Lashley, research professor of neuropsychology of Harvard University. The investigations regarding the geniculo-striate system, reflexes, orientation in space, brightness, form, color and so forth, in the behaviors of the intact and operated animals are considered by Professor Klüver. The problem of cerebral organization is dealt with by Doctor Lashley. In his opening remarks, Lashley says: "Thus practically the entire repertoire of visual functions of mammals is dependent upon the activity of the occipital cortex," and from that point on develops in a masterly fashion his thesis, to conclude that "The visual system is primarily concerned with spatial orientation and for it the transition from a sensory to motor pattern can be most adequately conceived as an interplay of polarized systems or of interweaving dynamic patterns in which the spatial properties of the visual stimulus are translated by integration at a series of levels into modifications of the general pattern of postural organization."

This is, in every sense of the word, a "must" book for those who are concerned with the pure or applied fields of physiological optics and vision.

CHARLES SHEARD, PH.D., SC.D.
PROFESSOR OF BIOPHYSICS
THE MAYO FOUNDATION, ROCHESTER, MINN.

ABSTRACTS

A department in which will appear abstracts of the literature of optometry, ophthalmology and applied optics. These will be classified according to the following list, although contributions to all sections will not necessarily appear in each issue.

1. Ocular Refraction.
2. Physiological Optics and Color Vision.
3. Ocular Muscles.
4. Orthoptics and Reading.
5. Anatomy, Histology and Embryology.
6. Ocular and General Pathology.
7. Ophthalmic Lenses and Material.
8. Instruments.
9. Hygiene and Illumination.
10. Applied and Physical Optics.
11. Education, Sociology and Economics.
12. Miscellaneous.

7. OPHTALMIC LENSES AND MATERIAL

CONTACT LENSES IN HIGH ASTIGMATISM. Adams, E. Optometric Weekly, 1941, 32, 43, 1214-1216.

Adams reports a case in which the patient was highly astigmatic. The corrective glasses not only failed to give normal vision but because

of their thickness were somewhat unsightly. Contact lenses were prescribed which improved both visual acuity and the appearance of the patient, who, according to Adams, developed a seven-hour daily tolerance for these subnormal vision devices.—C.C. K.

PLASTIC SPECTACLE LENSES. Emsley, H. H. Optician (London), 1941, 102, 2642, 191-193.

Plastic spectacle lenses are being made in England. These lenses are transparent to the visible spectrum. They retain their transparency, their surface polish and their mechanical strength under a wide variety of conditions. They are light in weight, have a high resistance to impact, a high resistance to splintering and are easy to manipulate. In addition to these qualities, surface condensation is very low, the lenses are light in weight, and the absorption in the short ultra-violet and near infrared radiations is high. From these standpoints, plastic lenses seem to have all of the advantages of lenses made from glass and some qualities lacking in ordinary lenses. However, Emsley points out that they have one serious defect, which overshadows their better properties from the standpoint of use in the field of spectacle wear. Plastic lenses are softer than glass. Although the moulding of plastic lenses is followed by a "hardening" process applied to the lens surface, the latter are definitely scratched more easily than the surfaces of glass lenses, obviously thus in time interfering with useful vision. The article reviews the manufacturing processes necessary in the making of plastic lenses, which are quite simple.—C. C. K.

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8. INSTRUMENTS.

BIOMICROSCOPY. Poser, M. Eye, Ear, Nose and Throat Monthly, 1941, 32, 4, 108-110.

This report contains a detailed description of the Bausch and Lomb Optical Company's new binocular microscope. The author presents the methods of construction as well as a review of its uses and techniques of operation.—C. C. K.

THE REFLEX AND ITS INFLUENCE UPON ACCURACY IN RETINOSCOPY. Barrett, C. D. Dioptric Review and British Journal of Physiological Optics (London), 1941 (new series), 2, 2, 137-149.

Barrett discusses methods which might be employed to improve the reflex observed when making a retinoscopic examination of an eye. Suggestions are presented to render the edge of the reflex as distinct as possible to produce greater ease and accuracy in neutralization. Barrett finds that the type and shape of the light source and the size of the sight hole are important factors and suggests additional experimental work to further improve retinoscopic design.—C. C. K.

A LID RETRACTOR FOR CONTACT LENS WORK. Mullen, J. Optical Journal and Review of Optometry, 1941, LXXVIII, 20. 30.

Mullen reviews some of the difficulties encountered in making an impression for a moulded contact lens, one of these being the problem of inserting the mold material under the upper lid. He describes a lid retractor which assists in simplifying this procedure.—C. C. K.

A REVIEW OF THE TECHNIQUE FOR RECORDING VISUAL ACUITY. A. Barnett. Optician (London), 1942, 103, 2661, 125-128.

Barnett believes Jurin to be the first to construct a visual test chart. This was done in 1674 in England. Jurin's test chart consisted of parallel black and white lines, each one inch across. With this chart placed in the open in sunlight, the ability to distinguish the lines at 287⅓ feet indicated normal vision. Barnett reviews the trials and experiments of a number of other investigators up to 1843 when Kuchler devised the first graduated scale of reading types. This was followed in 1854 by Jaeger, whose general form of near-point test types are still in use. The Snellen distance visual test chart was first introduced in 1862. The author presents a rather complete review of the subject of test charts up to the introduction of the broken ring test.—C. C. K.

DEPTH PERCEPTION. J. DeW. Harwood. Optometric Weekly, 1942, 33, 5, 119-120.

Harwood describes the Howard-Dolman Stereometric apparatus, known as the "peg" test, now used by the flying forces and the Civil Aeronautics Administration in testing the depth perception of flyers.

He also presents the technique of using this apparatus as well as a somewhat modified version of the instrument for clinical office use.—C. C. K.

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9. HYGIENE AND ILLUMINATION

SAFETY MEASURES AND EYE HEALTH SERVICE. J. A. Haller. Pennsylvania Optometrist, 1942, 11, 1, 41-45.

Haller is the Director of Safety of the State Industrial Accident Commission of Maryland. He claims that eye accidents cost the employer about $110,000,000 annually, and that 98 per cent of this can be prevented by proper safety engineering, education and enforcement.—C. C. K.

LABOR AND EYE HEALTH SERVICE IN THE NATIONAL WAR EFFORT. J. P. Casey. Pennsylvania Optometrist, 1942, 11, 1, 38-40.

The author presents five case reports wherein improper eye care resulted in the loss of vision following industrial eye injuries. Casey presents a plea for controlled industrial eye care.—C. C. K.

EYE PROTECTION IN THE DEFENSE INDUSTRIES. J. A. Haller. Sight Saving Review, 1942, 12, 1, 11-18.

The author, who is a specialist in industrial safety work, claims that at least 25 per cent of all accidents are due to bad lighting or a combination of bad lighting and subnormal vision. To reduce the number of industrial eye accidents he therefore suggests adequate lighting and corrective prescription glasses for all workers with visual problems. He points out that these measures will not only greatly reduce the accident ratio but will also increase operating efficiency.—T. O. B.

THE NATIONAL GOVERNMENT AND EYE HEALTH CARE. W. T. Cameron. Pennsylvania Optometrist, 1942, 11, 1, 4-8.

The author describes the Safety-Consulting Service now provided for all wartime industry by the National Committee for the Conservation of Manpower in Defense Industries, under the direction of the Secretary of Labor at Washington, D. C. In this program 400 safety engineers and safety directors, serving part-time, have been loaned

without cost to the committee by a number of large industrial corporations to serve all industry during the emergency. These men will advise both management and labor on unsafe working conditions and unsafe work practices and will assist in developing means of correcting these within the plants. Eyesight conservation plays an important part in their general safety program. Both factors of visual efficiency and proper lighting are also considered.—C. C. K.

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11. EDUCATION, SOCIOLOGY AND ECONOMICS

THE ECONOMICS OF EYE HEALTH SERVICE IN OUR NATIONAL WAR EFFORT. M. M. Davis. Pennsylvania Optometrist, 1942, 11, 1, 54-58.

The author is chairman of the Committee on Research of Medical Economics for New York State. He says, "Both economics and geography demonstrate that the needs of the people for eye care cannot be met by physicians alone. There is need for both eye physicians and optometrists. It is time that they agree amicably to dividing the field, which neither can cover alone, and in which both will make the best living if they work in cooperation rather than conflict. By so doing they will also come nearer to meeting the eye service needs of the American people. The cooperation between optometrists and eye physicians is not a dream. It now exists between many practitioners in many places. But it needs to include all such practitioners of both groups; to be more fully organized; to be based on explicit recognition of the respective functions of the ophthalmologists, the other eye physicians and the optometrists, and upon an understanding of their proper relations formulated by their respective national and state bodies." Davis believes the $140,000,000 now annually spent by the public for refractive care is not buying a sufficient amount of real service. The author believes that the costs of materials are excessive and the price to the consumer should be reduced. Davis finds that for the country as a whole, that 70 per cent of all refractions are made by optometrists.—C. C. K.

MOBILIZATION OF STATE FORCES FOR PREVENTION OF BLINDNESS. R. T. Lansdale. Sight-Saving Review, 1942, Supplement, 12, 1, 7-36.

The author points out the growing conviction that many of our personal and social difficulties are preventable, and indicates that this

thinking has gradually pushed public policy to a point where positive preventive action on the part of federal and state governments is expected. Because of the factors involved, however, it is both necessary and vital that the program be both co-ordinated and flexible. This applies to general programs of care as well as to programs of blindness prevention. The job will only be done well, Lansdale points out, when all governmental agencies co-operate, as it is not the job only of some one bureau. The author presents much statistical data as to the work now being done, in the field of blindness prevention, by state governmental units—T. O. B.

PUBLIC HEALTH OPTOMETRY AND DEFENSE IN YOUR COMMUNITY. Feinbloom, W. Kentucky Optometrist, 1942, 15, 11, 3-5.

Feinbloom discusses the services to be rendered by an optometric local society in times of war. He suggests that the society can best serve the profession by (1) interpreting administrative regulations to the practitioners in the field, in order to secure uniform and equitable administration throughout county and state areas. (2) Assist in the formation of standard examination procedures fitted to various needs. (3) Classify all optometrists according to their qualifications. (4) Classify all qualified optometrists according to their availability for public service. (5) Determine the most economical method for the distribution of necessary optometric services, and (6) assist in the work of evaluating new diagnostic and refractive techniques.—T. O. B.

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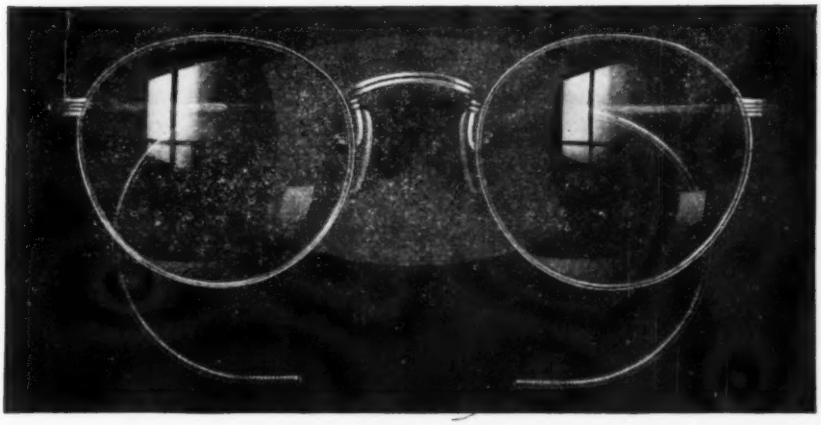

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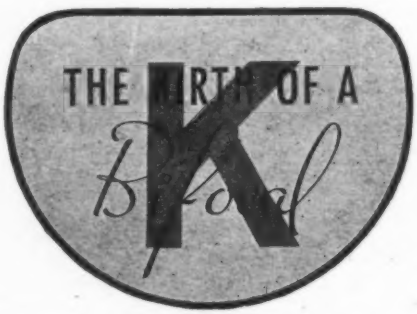

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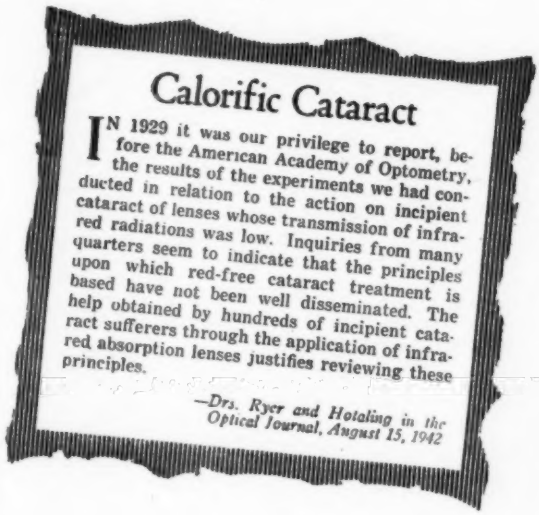

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—*Drs. Ryer and Hotaling in the Optical Journal, August 15, 1942*

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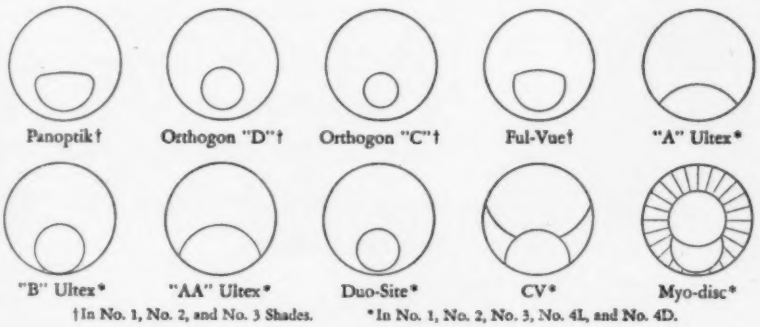

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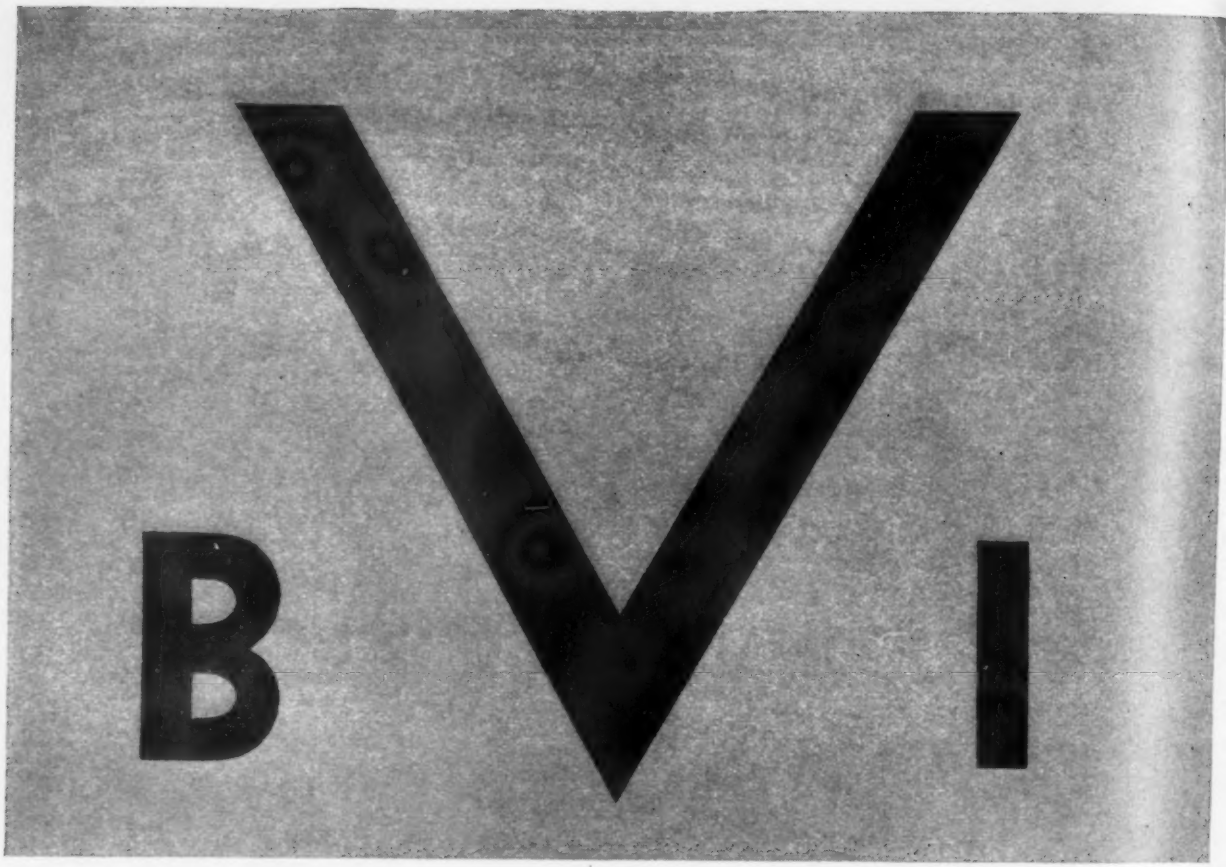

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